Westinghouse

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Nuclear Plant Projects
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USA

U.S. Nuclear Regulatory Commission
ATTENTION: Document Control Desk
Washington, D.C. 20555

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Your ref: Docket No. 52-006
Our ref: DCP/NRC1530

November 1, 2002

SUBJECT: Transmittal of Westinghouse Proprietary and Non-Proprietary Responses to U.S. Nuclear Regulatory Commission Requests for Additional Information Related to Structural Design for the AP1000 Application for Design Certification

This letter transmits the Westinghouse responses to NRC Requests for Additional Information (RAI) regarding our application for Design Certification of the AP1000 standard plant. The list of RAI responses that are transmitted with this letter is provided in Attachment 1. Attachments 2 and 3 to this letter provide the proprietary and non-proprietary responses to the NRC RAI.

The RAI responses included in this letter are those additional responses that we have completed from the series 220 RAI. We plan to provide you with answers to the remaining questions in this series prior to our meeting on November 12 in our offices.

The Westinghouse Electric Company Copyright Notice, Proprietary Information Notice, Application for Withholding, and Affidavit are also enclosed with this submittal letter as Enclosure 1. Attachment 2 contains Westinghouse proprietary information consisting of trade secrets, commercial information or financial information which we consider privileged or confidential pursuant to 10 CFR 2.790. Therefore, it is requested that the Westinghouse proprietary information attached hereto be handled on a confidential basis and be withheld from public disclosures. Attachment 3 contains no proprietary information.

This material is for your internal use only and may be used for the purpose for which it is submitted. It should not be otherwise used, disclosed, duplicated, or disseminated, in whole or in part, to any other person or organization outside the Commission, the Office of Nuclear Reactor Regulation, the Office of Nuclear Regulatory Research and the necessary subcontractors that have signed a proprietary non-disclosure agreement with Westinghouse without the express written approval of Westinghouse.

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Correspondence with respect to the application for withholding should reference AW-02-1567, and should be addressed to Hank A. Sepp, Manager of Regulatory and Licensing Engineering, Westinghouse Electric Company, P.O. Box 355, Pittsburgh, Pennsylvania, 15230-0355.

Please contact me at 412-374-5355 if you have any questions concerning this submittal.

Very truly yours,

M. M. Corletti
Passive Plant Projects & Development
AP600 & AP1000 Projects

cc: Dr. Carl Costantino - Spring Valley, N.Y.
Mr. Richard Morante - Brookhaven National Laboratory, Upton, N.Y.
Mr. Tom Tsai - Lafayette, CA

/Enclosure

1. Westinghouse Electric Company Copyright Notice, Proprietary Information Notice, Application for Withholding, and Affidavit AW-02-1567

/Attachments

1. Table 1, "List of Westinghouse's Responses to RAIs Transmitted in DCP/NRC1530"

2. Westinghouse Proprietary Response to US Nuclear Regulatory Commission Requests for Additional Information dated November 2002

3. Westinghouse Non-Proprietary Response to US Nuclear Regulatory Commission Requests for Additional Information dated November 2002

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November 1, 2002

Enclosure 1

Westinghouse Electric Company
Copyright Notice, Proprietary Information Notice, Application for Withholding, and Affidavit

DCP/NRC1530
Docket No. 52-006

November 1, 2002

Copyright Notice

The documents transmitted herewith each bear a Westinghouse copyright notice. The NRC is permitted to make the number of copies of the information contained in these reports which are necessary for its internal use in connection with generic and plant-specific reviews and approvals as well as the issuance, denial, amendment, transfer, renewal, modification, suspension, revocation, or violation of a license, permit, order, or regulation subject to the requirements of 10 CFR 2.790 regarding restrictions on public disclosure to the extent such information has been identified as proprietary by Westinghouse, copyright protection notwithstanding. With respect to the non-proprietary versions of these reports, the NRC is permitted to make the number of copies beyond these necessary for its internal use which are necessary in order to have one copy available for public viewing in the appropriate docket files in the public document room in Washington, DC and in local public document rooms as may be required by NRC regulations if the number of copies submitted is insufficient for this purpose. Copies made by the NRC must include the copyright notice in all instances and the proprietary notice if the original was identified as proprietary.

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Proprietary Information Notice

Transmitted herewith are proprietary and/or non-proprietary versions of documents furnished to the NRC in connection with requests for generic and/or plant-specific review and approval.

In order to conform to the requirements of 10 CFR 2.790 of the Commission's regulations concerning the protection of proprietary information so submitted to the NRC, the information which is proprietary in the proprietary versions is contained within brackets, and where the proprietary information has been deleted in the non-proprietary versions, only the brackets remain (the information that was contained within the brackets in the proprietary versions having been deleted). The justification for claiming the information so designated as proprietary is indicated in both versions by means of lower case letters (a) through (f) located as a superscript immediately following the brackets enclosing each item of information being identified as proprietary or in the margin opposite such information. These lower case letters refer to the types of information Westinghouse customarily holds in confidence identified in Sections (4)(ii)(a) through (4)(ii)(f) of the affidavit accompanying this transmittal pursuant to 10 CFR 2.790(b)(1).

Westinghouse Electric Company
Nuclear Plant Projects
P.O. Box 355
Pittsburgh, Pennsylvania 15230-0355
USA

November 1, 2002

AW-02-1567

Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555

ATTENTION: Mr. Lawrence Burkhart

APPLICATION FOR WITHHOLDING PROPRIETARY INFORMATION FROM PUBLIC DISCLOSURE

SUBJECT: Transmittal of Westinghouse Proprietary Class 2 and Non-Proprietary Class 3 versions of Document: "AP1000 Design Certification Review – Responses to Requests for Additional Information"

Dear Mr. Burkhart:

The application for withholding is submitted by Westinghouse Electric Company, LLC ("Westinghouse") pursuant to the provisions of paragraph (b)(1) of Section 2.790 of the Commission's regulations. It contains commercial strategic information proprietary to Westinghouse and customarily held in confidence.

The proprietary material for which withholding is being requested is identified in the proprietary version of the subject documents. In conformance with 10 CFR Section 2.790, Affidavit AW-02-1567 accompanies this application for withholding setting forth the basis on which the identified proprietary information may be withheld from public disclosure.

Accordingly, it is respectfully requested that the subject information which is proprietary to Westinghouse be withheld from public disclosure in accordance with 10 CFR Section 2.790 of the Commission's regulations.

Correspondence with respect to this application for withholding or the accompanying affidavit should reference AW-02-1567 and should be addressed to the undersigned.

Very truly yours,

Michael M. Corletti

M. M. Corletti
Passive Plant Projects & Development
AP600 & AP1000 Projects

/Enclosures

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AW-02-1567

COMMONWEALTH OF PENNSYLVANIA:

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COUNTY OF ALLEGHENY:

Before me, the undersigned authority, personally appeared James W. Winters, who, being by me duly sworn according to law, deposes and says that he is authorized to execute this Affidavit on behalf of Westinghouse Electric Company, LLC ("Westinghouse"), and that the averments of fact set forth in this Affidavit are true and correct to the best of his knowledge, information, and belief:

KAY E. GONGAWARE
COMMONWEALTH OF PENNSYLVANIA
NOTARY PUBLIC

James W. Winters, Manager
Passive Plant Projects & Development
Nuclear Plant Projects
Westinghouse Electric Company, LLC

Sworn to and subscribed
before me this 1st day
of November, 2002

Kay E. Gongaware
Notary Public

Notarial Seal
Kay E. Gongaware, Notary Public
Monroeville Boro, Allegheny County
My Commission Expires Feb. 7, 2005
Member, Pennsylvania Association of Notaries

(1) I am Manager, Passive Plant Projects & Development, in the Nuclear Plant Projects Business Unit, of the Westinghouse Electric Company LLC ("Westinghouse"), and as such, I have been specifically delegated the function of reviewing the proprietary information sought to be withheld from public disclosure in connection with nuclear power plant licensing and rulemaking proceedings, and am authorized to apply for its withholding on behalf of the Westinghouse Electric Company, LLC.

(2) I am making this Affidavit in conformance with the provisions of 10 CFR Section 2.790 of the Commission's regulations and in conjunction with the Westinghouse application for withholding accompanying this Affidavit.

(3) I have personal knowledge of the criteria and procedures utilized by the Westinghouse Electric Company, LLC in designating information as a trade secret, privileged or as confidential commercial or financial information.

(4) Pursuant to the provisions of paragraph (b)(4) of Section 2.790 of the Commission's regulations, the following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld.

(i) The information sought to be withheld from public disclosure is owned and has been held in confidence by Westinghouse.

(ii) The information is of a type customarily held in confidence by Westinghouse and not customarily disclosed to the public. Westinghouse has a rational basis for determining the types of information customarily held in confidence by it and, in that connection, utilizes a system to determine when and whether to hold certain types of information in confidence. The application of that system and the substance of that system constitutes Westinghouse policy and provides the rational basis required.

Under that system, information is held in confidence if it falls in one or more of several types, the release of which might result in the loss of an existing or potential competitive advantage, as follows:

(a) The information reveals the distinguishing aspects of a process (or component, structure, tool, method, etc.) where prevention of its use by any of Westinghouse's competitors without license from Westinghouse constitutes a competitive economic advantage over other companies.

(b) It consists of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), the application of which data secures a competitive economic advantage, e.g., by optimization or improved marketability.

(c) Its use by a competitor would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing a similar product.

(d) It reveals cost or price information, production capacities, budget levels, or commercial strategies of Westinghouse, its customers or suppliers.

(e) It reveals aspects of past, present, or future Westinghouse or customer funded development plans and programs of potential commercial value to Westinghouse.

(f) It contains patentable ideas, for which patent protection may be desirable.

There are sound policy reasons behind the Westinghouse system which include the following:

(a) The use of such information by Westinghouse gives Westinghouse a competitive advantage over its competitors. It is, therefore, withheld from disclosure to protect the Westinghouse competitive position.

(b) It is information which is marketable in many ways. The extent to which such information is available to competitors diminishes the Westinghouse ability to sell products and services involving the use of the information.

(c) Use by our competitor would put Westinghouse at a competitive disadvantage by reducing his expenditure of resources at our expense.

(d) Each component of proprietary information pertinent to a particular competitive advantage is potentially as valuable as the total competitive advantage. If competitors acquire components of proprietary information, any one component may be the key to the entire puzzle, thereby depriving Westinghouse of a competitive advantage.

(e) Unrestricted disclosure would jeopardize the position of prominence of Westinghouse in the world market, and thereby give a market advantage to the competition of those countries.

(f) The Westinghouse capacity to invest corporate assets in research and development depends upon the success in obtaining and maintaining a competitive advantage.

(iii) The information is being transmitted to the Commission in confidence and, under the provisions of 10 CFR Section 2.790, it is to be received in confidence by the Commission.

(iv) The information sought to be protected is not available in public sources or available information has not been previously employed in the same original manner or method to the best of our knowledge and belief.

The proprietary information sought to be withheld in this submittal is that which is appropriately marked in Attachment 1 as Proprietary Class 2 in the Westinghouse document DCP/NRC1530 for submittal to the Commission: (1) "AP1000 Design Certification Review – Response to Requests for Additional Information."

This information is being transmitted by Westinghouse's letter and Application for Withholding Proprietary Information from Public Disclosure, being transmitted by Westinghouse Electric Company (W letter AW-02-1567) and to the Document Control Desk, Attention: Lawrence Burkhart, DIPM/NRLPO, MS O-4D9A.

This information is part of that which will enable Westinghouse to:

(a) Provide documentation supporting determination of APP-GW-GL-700, "AP1000 Design Certification Document," analysis on a plant specific basis

(b) Provide the applicable engineering evaluation which establishes the Tier 2 requirements as identified in APP-GW-GL-700.

Further this information has substantial commercial value as follows:

(a) Westinghouse plans to sell the use of similar information to its customers for purposes of meeting NRC requirements for Licensing Documentation.

(b) Westinghouse can sell support and defense of AP1000 Design Certification.

Public disclosure of this proprietary information is likely to cause substantial harm to the competitive position of Westinghouse because it would enhance the ability of competitors to provide similar methodologies and licensing defense services for commercial power reactors without commensurate expenses. Also, public disclosure of the information would enable others to use the information to meet NRC requirements for licensing documentation without purchasing the right to use the information.

The development of the technology described in part by the information is the result of applying the results of many years of experience in an intensive Westinghouse effort and the expenditure of a considerable sum of money.

In order for competitors of Westinghouse to duplicate this information, similar technical programs would have to be performed and a significant manpower effort, having the requisite talent and experience, would have to be expended for performing and analyzing tests.

Further the deponent sayeth not.

DCP/NRC1530
Docket No. 52-006

November 1, 2002

Attachment 1

List of Westinghouse's Responses to RAIs Transmitted in DCP/NRC1530

Table 1 "List of Westinghouse's Responses to RAIs Transmitted in DCP/NRC1530"
220.006
220.008
220.009
220.009P
220.011
220.013
220.014
220.019

DCP/NRC1530
Docket No. 52-006

November 1, 2002

Attachment 3

"AP1000 Design Certification Review –
Response to Request for Additional Information"

AP1000 DESIGN CERTIFICATION REVIEW

Response to Request For Additional Information

RAI Number: 220.006

Question:

AP1000 DCD Subsection 3.8.3.1, "Description of the Containment Internal Structures," states that "The steel surface plates of the structural modules provide reinforcement in the concrete and anchor the structural modules to the base concrete." According to Figure 3.8.3-8 and the AP600 design, the structural modules also require anchoring to the concrete with mechanical connectors/rebars. Westinghouse is requested to clarify the statement in Subsection 3.8.3.1, specifically explaining whether the steel surface plates are sufficient to provide anchorage to the concrete or if additional mechanical connectors/rebars are also required. If additional mechanical connectors/rebars are required, identify where the details are described in the AP1000 DCD or provide the details as part of the response.

Westinghouse Response:

Structural modules are anchored to the base concrete to resist the reactions obtained from the design analyses. The anchorage design is developed in accordance with ACI 349 and typical details are shown in Figure 3.8.3-8. Reinforcement is provided to resist tension. The connection between the steel plate module and the reinforced concrete basemat is a combination of mechanical connections welded to the steel plate and lap splices where the reinforcement overlaps shear studs on the steel plate.

See also the response to RAI Number 220.011.

Design Control Document (DCD) Revision:

Revise fourth paragraph of subsection 3.8.3.1 as follows:

Walls and floors are concrete filled steel plate structural modules. The walls are supported on the mass concrete containment internal structures basemat with the steel surface plate extending down to the concrete floor on each side of the wall. The steel surface plates of the structural modules provide reinforcement in the concrete. ~~and anchor t~~The structural modules **are anchored** to the base concrete **by a combination of mechanical connections, shear studs or reinforcement as shown in Figure 3.8.3-8.** Figure 3.8.3-1 shows the location of the structural modules. Figures 3.8.3-2 and 3.8.3-15 show the typical structural configuration of the wall modules. A typical floor module is shown in Figure 3.8.3-3 and also in Figure 3.8.3-16 combined with the liner module. These structural modules are structural elements built up with welded steel structural shapes and plates. Concrete is used where required for shielding, but reinforcing steel is not normally used.

Revise last paragraph of subsection 3.8.3.5.3

Figure 3.8.3-8 shows the typical design details of the structural modules, typical configuration of the wall modules, typical anchorages of the wall modules to the reinforced base concrete, and connections between adjacent modules. Concrete-filled structural wall modules are designed as reinforced concrete structures in accordance with the requirements of ACI-349, as supplemented in the following paragraphs. The faceplates are considered as the reinforcing steel, bonded to the concrete by headed studs. The application of ACI-349 and the supplemental requirements are supported by the behavior studies described in subsection 3.8.3.4.1. **The connection between the steel plate module and the reinforced concrete basemat is a combination of mechanical connections welded to the steel plate or lap splices where the reinforcement overlaps shear studs on the steel plate.** The design of critical sections is described in subsection 3.8.3.5.8.

PRA Revision:

None

AP1000 DESIGN CERTIFICATION REVIEW

Response to Request For Additional Information

RAI Number: 220.008

Question:

AP1000 DCD Subsection 3.8.3.4.1.2, "Stiffness Assumptions for Global Seismic Analyses," indicates that the in-plane concrete shear stresses calculated for the AP600 containment internal structural modules would increase slightly for the AP1000 due to increased height of modular walls and increased mass and size of the steam generators and pressurizer. In addition, this subsection states that the stresses will still be well below the magnitude causing significant cracking of the concrete, so the monolithic assumption is still appropriate. Please provide the technical basis to demonstrate the above statements and conclusions.

Westinghouse Response:

As stated in subsection 3.8.3.4.1.2 of the AP1000 Design Control Document, the maximum in-plane concrete shear stresses in the AP600 containment internal structures modules are 97 psi for the 48-inch wall and 137 psi for the 30-inch wall due to the safe shutdown earthquake based on the monolithic section properties.

Table 3.7.2-13 of both the AP600 and AP1000 Design Control Documents show the maximum member forces in the containment internal structures from time history seismic analyses. At elevation 107' 2" the member forces for the hard rock site are:

	Maximum Forces ($x10^3$ Kips)			Maximum Moment ($x10^3$ K-ft)		
Elevation (ft)	Axial	N-S Shear	E-W Shear	Torque	About N-S Axis	About E-W Axis
AP600						
107.17	1.99	5.83	6.07	247.50	219.60	196.10
AP1000						
107.17	3.32	7.33	7.11	106.43	258.27	242.74

The north-south shear increases by 25%, the east-west shear by 17%. This increase is partially due to the increased mass of the compartments and equipment above the operating floor and partly due to changing the boundary conditions in the seismic analysis and removing the lateral support below grade for the hard rock site. If the 137 psi for the 30-inch wall increase the maximum 25% it would not cause significant cracking of the concrete, so the monolithic assumption is still appropriate.

AP1000 DESIGN CERTIFICATION REVIEW

Response to Request For Additional Information

Design Control Document (DCD) Revision:

None

PRA Revision:

None

AP1000 DESIGN CERTIFICATION REVIEW

Response to Request For Additional Information

RAI Number: 220.009

Question:

Hydrodynamic analyses performed for the AP600 are described in AP1000 DCD Subsection 3.8.3.4.2. This subsection indicates that due to the "minor" differences between the AP600 design and the AP1000 design, the 5 psi pressure design basis for the tank boundary is also applicable to the AP1000. From the information provided, it is not evident that the changes in the structural elements and masses can be considered to be "minor." Therefore, Westinghouse is requested to provide the following information:

1. The technical basis for concluding that the increase in wall heights and mass of the steam generator and pressurizer will have a minor effect on the structural frequencies.

2. Explain how the range of frequencies considered in the AP600 time history analyses adequately cover the expected frequency shifts caused by the differences between the AP600 and AP1000 design.

3. What was the margin between the maximum wall pressure calculated from the analyses and the 5 psi pressure used as the design basis for the AP600 tank boundary?

Westinghouse Response:

1. The statements given in the AP1000 DCD recognize that the small change in frequencies due to the increase in wall heights of the compartments and the mass of the steam generator and pressurizer will not change the structural response due to the hydrodynamic loading. The basis of this statement is:

   a. The hydrodynamic time history content is basically of "white noise" character. See discussion under item 2.

   b. The changes to the steam generator and pressurizer compartment designs (steam generator compartment height increases 5' and the pressurizer compartment height increases 11' in the AP1000 plant when compared to the AP600 plant), and the steam generator and pressurizer components will not significantly affect the response of the IRWST boundaries during the hydrodynamic transients.

      There are two automatic depressurization system (ADS) load cases, ADS_1 and ADS_2. The ADS_1 loading transient is associated with blowdown of the primary system through the spargers when the water in the IRWST is cold and the tank is at ambient pressure. Condensation during sparger discharge results in high frequency pressure oscillation, primarily in a frequency range of 40 to 60 hertz. The ADS_2 transient is associated with

blowdown of the primary system through the spargers after prolonged operation of the passive residual heat removal (RHR) that heats up the water in the IRWST. Since the flow through the sparger cannot fully condense in the saturated conditions, the pressure increases in the IRWST and steam is vented through the IRWST roof vents. The ADS_2 loads are treated as positive or negative and control the structural design.

Walls of the west steam generator compartment, pressurizer compartment, and the reactor cavity are boundaries of the IRWST. The AP1000 changes only affect the continuation of these walls above the operating floor and do not affect the IRWST boundaries below the operating floor. The hydrodynamic loads that excite these boundaries result from blowdown through the spargers. The spargers are located in the south end of the IRWST. The four foot thick west wall of the refueling cavity and the 30 inch thick south wall of the steam generator cavity are subject to the greatest energy of the transient forcing function. The four foot thick refueling cavity wall is not changed from the AP600 design. It is a rigid structure that will not be affected by the changes made to the steam generator and pressurizer compartments and components. The west wall of the steam generator compartment and the walls of the pressurizer compartment are shielded from the direct effect of the spargers, and see less dynamic excitation due to the hydrodynamic forcing function. Consequently, the changes to the pressurizer compartment and pressurizer will not have any significant effect on the IRWST forces from the hydrodynamic excitations.

The south wall of the steam generator compartment is most affected by the transients. The south wall is a 30 inch thick concrete filled CA structural module with approximate dimensions of 30' by 30'. Considering the mass of the IRWST concrete module walls, the contributing water mass, and the steam generator cavity mass, the increase in mass from the AP600 design is less than ten percent (frequency change less than 5%). Due to the arrangement of the steam generator intermediate and upper supports the steam generator mass in the North-South direction is transferred directly into the operating deck, and the steam generator mass in the East-West direction directly into the plane of the north and south walls of the steam generator compartment. Thus the increase in steam generator mass has little effect on the out-of-plane response of the south wall of the steam generator compartment. Therefore, the changes to the steam generator and compartment will not be significant to the IRWST hydrodynamic response.

2. Two forcing functions are used in the IRWST hydrodynamic analyses. The response spectra for these two transients are characteristic of a "white noise" type of forcing function for the associated frequency content of each forcing function. One of the time histories used for the structural hydrodynamic analysis has significant content for frequencies below 40 hertz (referred to as Test 330), and the other has significant content in the frequency range from 40 to 60 hertz (referred to as Test 930). The response spectra for these two time histories are shown in the figures below. As seen from Figures 220.009-1 and 220.009-2, any shift in structural frequency will not affect the structural response because of the white noise characteristics of the forcing functions.

3. The hydrodynamic analyses show that member forces in the walls of the in-containment refueling water storage tank are bounded by a case with a uniform pressure of 5-psi applied to the walls. The IRWST is designed for a uniform pressure of 5 psi applied to the walls. This pressure is taken as both positive and negative due to oscillatory nature of the hydrodynamic loads. Tables 220.009-1 and 220.009-2 compare the hydrodynamic and 5 psi lateral pressure loading. As seen from these tables, there is significant margin in the uniform 5-psi pressure case when compared to the hydrodynamic results. The comparison is made for the components that control design (i.e., out-of-plane bending; values given are in local coordinates with x horizontal and y vertical in the plane of the wall). Note that absolute values are given because of the oscillatory nature of the loading.

Based on the above, the "minor" differences between the AP600 design and the AP1000 design will not affect the AP600 5-psi pressure design basis for the tank boundary since:

- Changes to the AP1000 plant design will not result in frequency responses that significantly change the member forces that control the IRWST design that is based on the AP600 plant design.

- The AP600 and AP1000 plant designs are based on the uniform 5-psi loading that envelopes the hydrodynamic pressure at locations of the wall that control design.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Table 220.009- 1
Member Forces Due to Hydrodynamic and Lateral Pressure
West Wall of Refueling Cavity

Element	Location	Moment	Hydrodynamic [Units: kip-ft / ft]	Uniform 5 psi pressure [Units: kip-ft / ft]	Margin (5 psi / hydro)
1852	South edge at mid span	Mx	5.40	22.93	4.25
1876	Mid span at mid height	Mx	13.94	25.63	1.84
1908	North edge at mid span	Mx	11.91	20.91	1.75
1876	Mid span at mid height	My	17.98	19.56	1.09
1880	Mid span at base	My	20.68	34.17	1.65

Table 220.009-2
Member Forces Due to Hydrodynamic and Lateral Pressure
South Wall of Steam Generator Cavity

Element	Location	Moment	Hydrodynamic [Units: kip-ft / ft]	Uniform 5 psi pressure [Units: kip-ft / ft]	Margin (5 psi / hydro)
1917	East edge at mid span	Mx	22.26	29.22	1.31
1957	Mid span at mid height	Mx	13.94	16.64	1.19
2005	West edge at mid span	Mx	7.42	20.91	2.82
1957	Mid span at mid height	My	15.06	16.41	1.09
1960	Mid span at base	My	20.46	23.83	1.16

[ ] b,c

Figure 220.009-1 – Response Spectrum for Test 330 (10-30 Seconds)

b,c

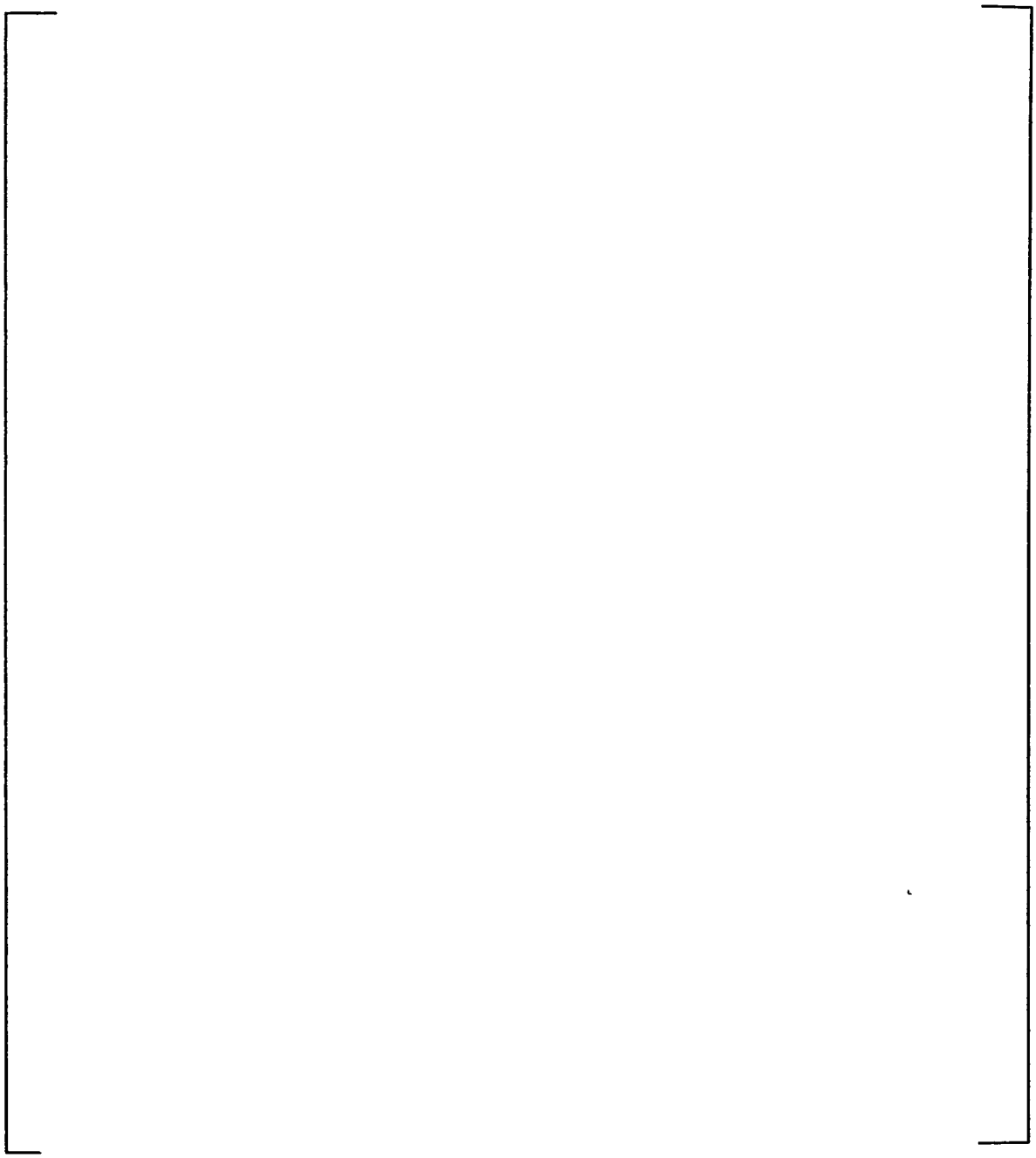

Figure 220.009-2 – Response Spectra for Test 930 (20-40 and 26.2-27.2 Seconds)

AP1000 DESIGN CERTIFICATION REVIEW

Response to Request For Additional Information

RAI Number: 220.011

Question:

AP1000 DCD Figure 3.8.3-1 (sheets 1 through 7) refers to three types of wall modules: CA Structure Wall Module, Left-in-Place Form, and CA Structure Module With Single Surface Plate. Please provide the following information:

A. A description, design approach, and analytical methods are provided for the first two types of modules; however, no descriptive information has been identified for the CA Structure Module With Single Surface Plate. A description for the CA type module similar to the information provided for the other two modules should be provided.

B. On this figure, sheets 1, 2, 4, 6, and 7, there are solid heavy lines (without tick marks) for a structural module. However, this marking is not identified on the "Key." Please explain what is meant by the solid heavy line marking.

Westinghouse Response:

A. The CA Structure Module With Single Surface Plate is an extension of the CA type wall module with two plates. Plates on each face of the wall module extend down to the elevation of the adjacent floor. Since the floors in the rooms each side of the wall module are at different elevations one of the plates extends further than the other. This portion is designated on the figures as "Structure Module With Single Surface Plate". A typical configuration is shown in Figure 3.8.3-8. The module functions as a wall above the upper floor level (elevation 103' 0" in Figure 3.8.3-8). The single plate below this elevation is designed to transfer the reactions at the base of the wall into the base mat. This plate also acts as face reinforcement for the basemat. Basemat reinforcement dowels are provided at the bottom of the single plate as shown in Figure 3.8.3-8.

B. On DCD Figure 3.8.3-1, sheets 1, 2, 4, 6, and 7, the solid heavy lines (without tick marks) are the two faces of the CA structural wall module. The heavy lines are joined by a representation of the trusses and are identified on the "Key." This representation is missing on some sheets and is being added.

Design Control Document (DCD) Revision:

Revise second paragraph of subsection 3.8.3.1.3:

Structural wall modules consist of steel faceplates connected by steel trusses. The primary purpose of the trusses is to stiffen and hold together the faceplates during handling, erection, and concrete placement. The nominal thickness of the steel faceplates is 0.5 inch. The nominal spacing of the trusses is 30 inches. Shear studs are welded to the inside faces of the steel faceplates. Face plates are welded to adjacent plates with full penetration welds so that the weld is at least as strong as the plate. **Plates on each face of the wall module extend down to the elevation of the adjacent floor. A typical configuration is shown in Figure 3.8.3-8.** The structural wall modules are anchored to the concrete base by reinforcing steel dowels or other types of connections embedded in the reinforced concrete below. After erection, concrete is placed between the faceplates. Typical details of the structural modules are shown in Figures 3.8.3-2, 3.8.3-8 and 3.8.3-17.

Revise Figure 3.8.3-1 as shown in attached figures.

PRA Revision:

None

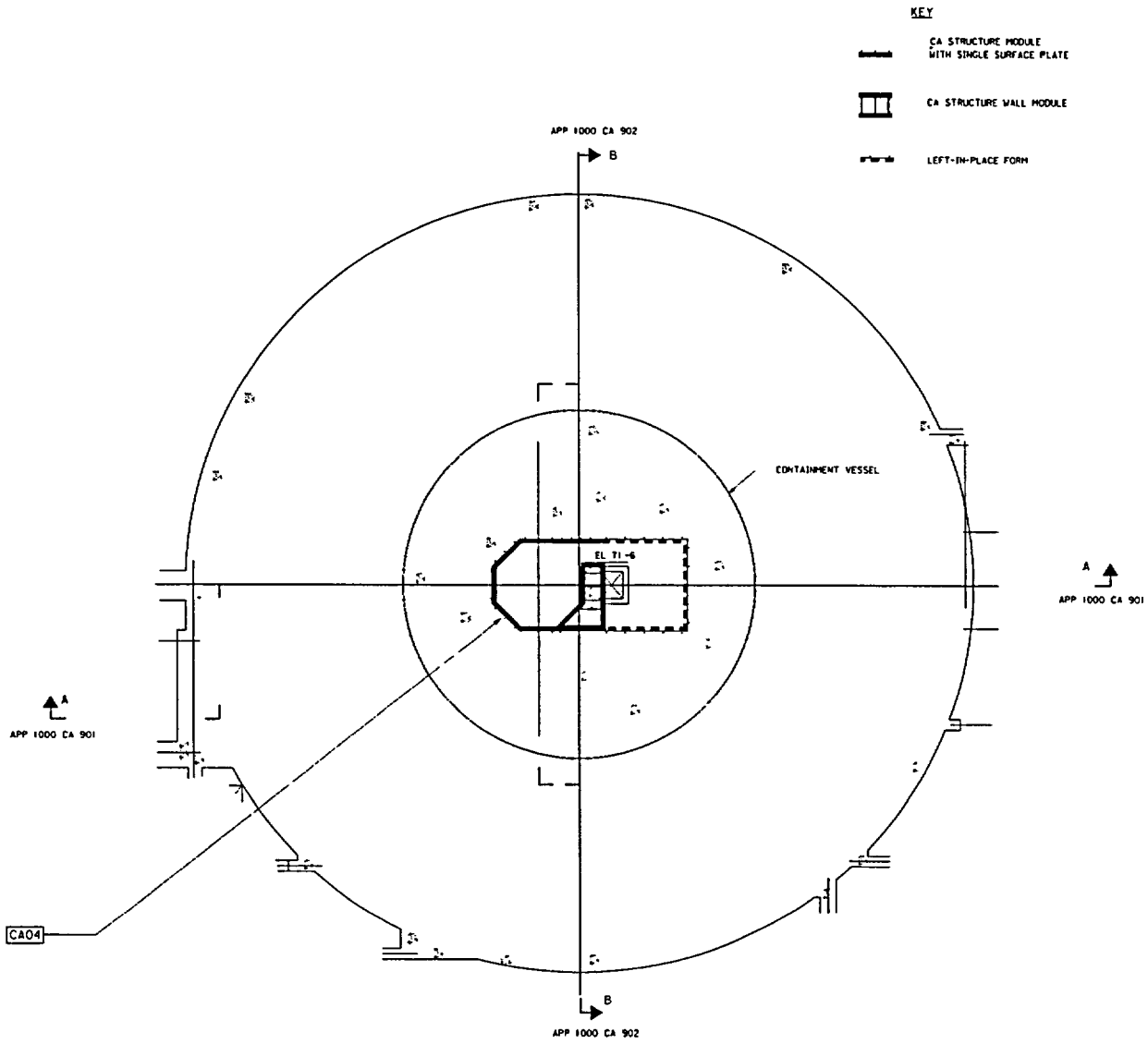

Figure 3.8.3-1 (Sheet 1 of 7)

*[Structural Modules in Containment Internal Structures]**

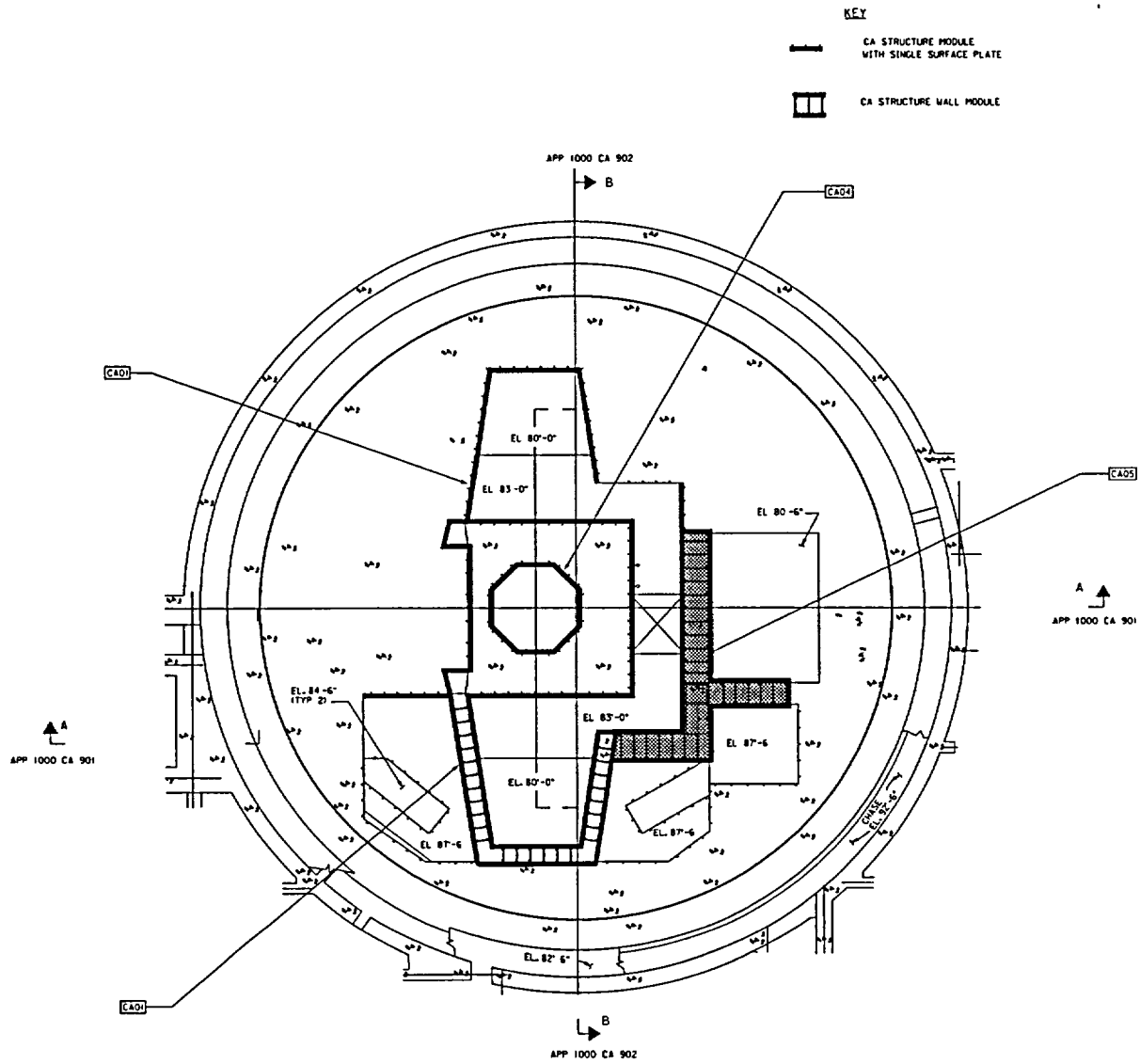

Figure 3.8.3-1 (Sheet 2 of 7)

*[Structural Modules in Containment Internal Structures]**

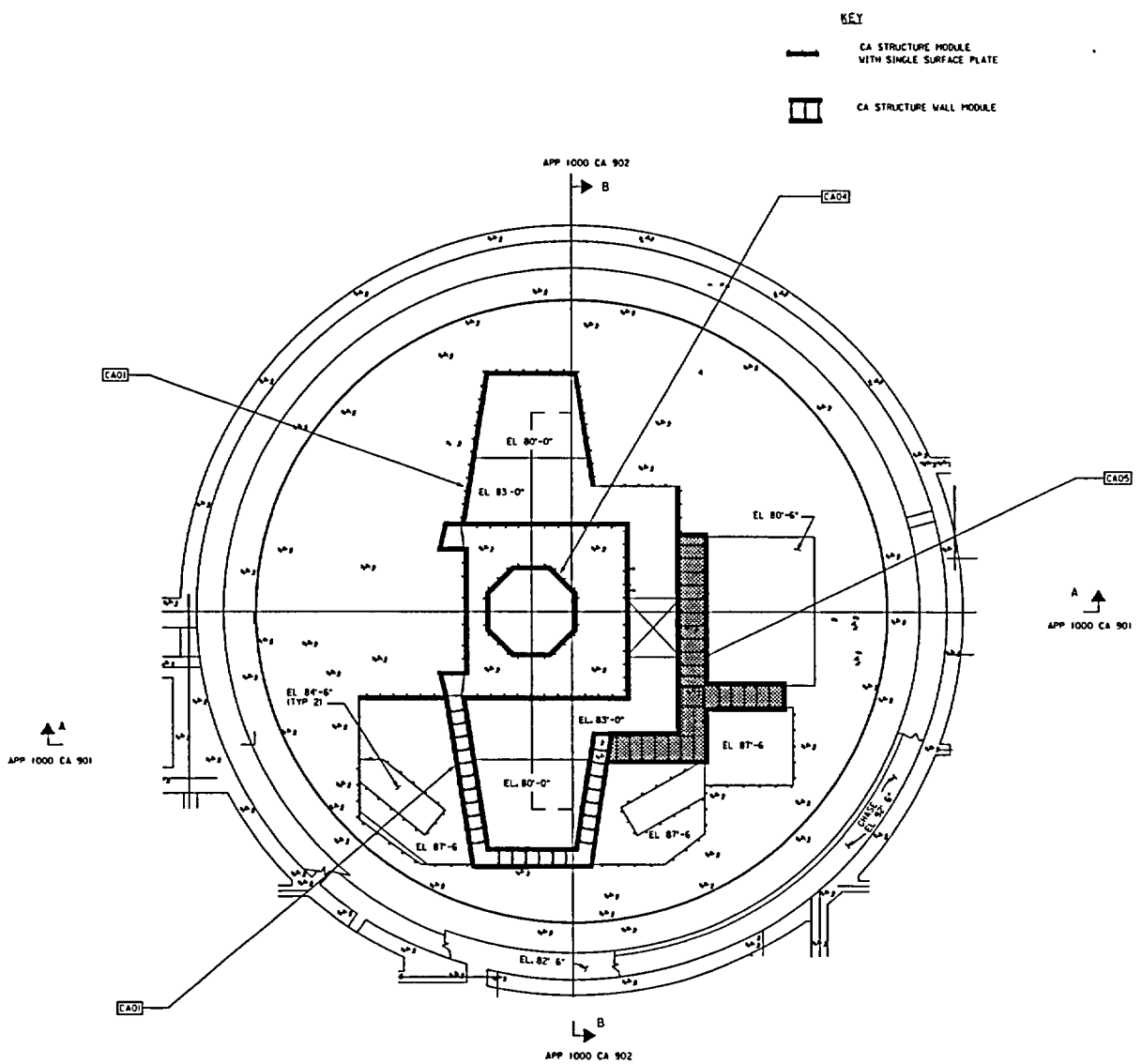

Figure 3.8.3-1 (Sheet 3 of 7)

*[Structural Modules in Containment Internal Structures]**

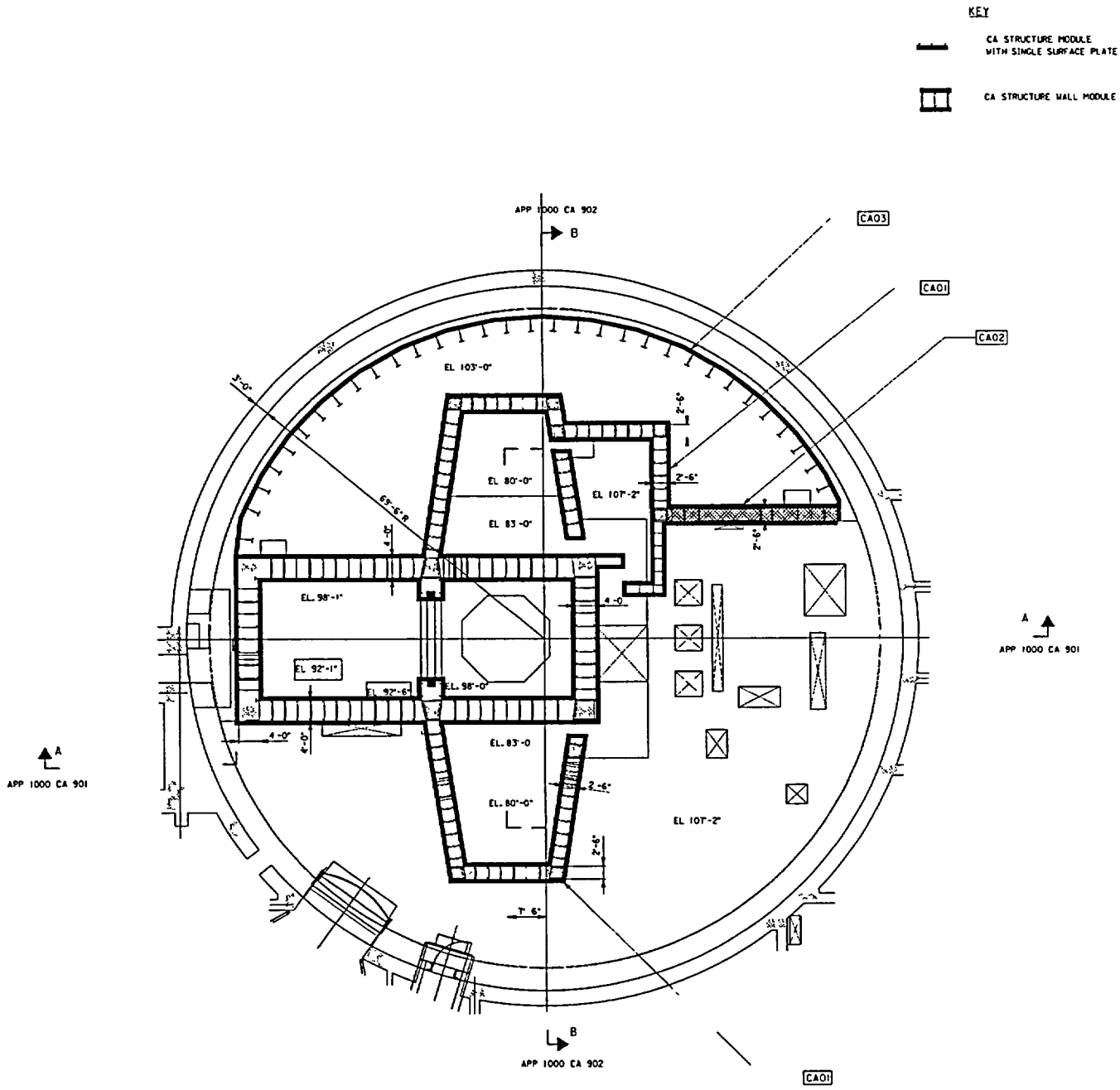

Figure 3.8.3-1 (Sheet 4 of 7)

*[Structural Modules in Containment Internal Structures]**

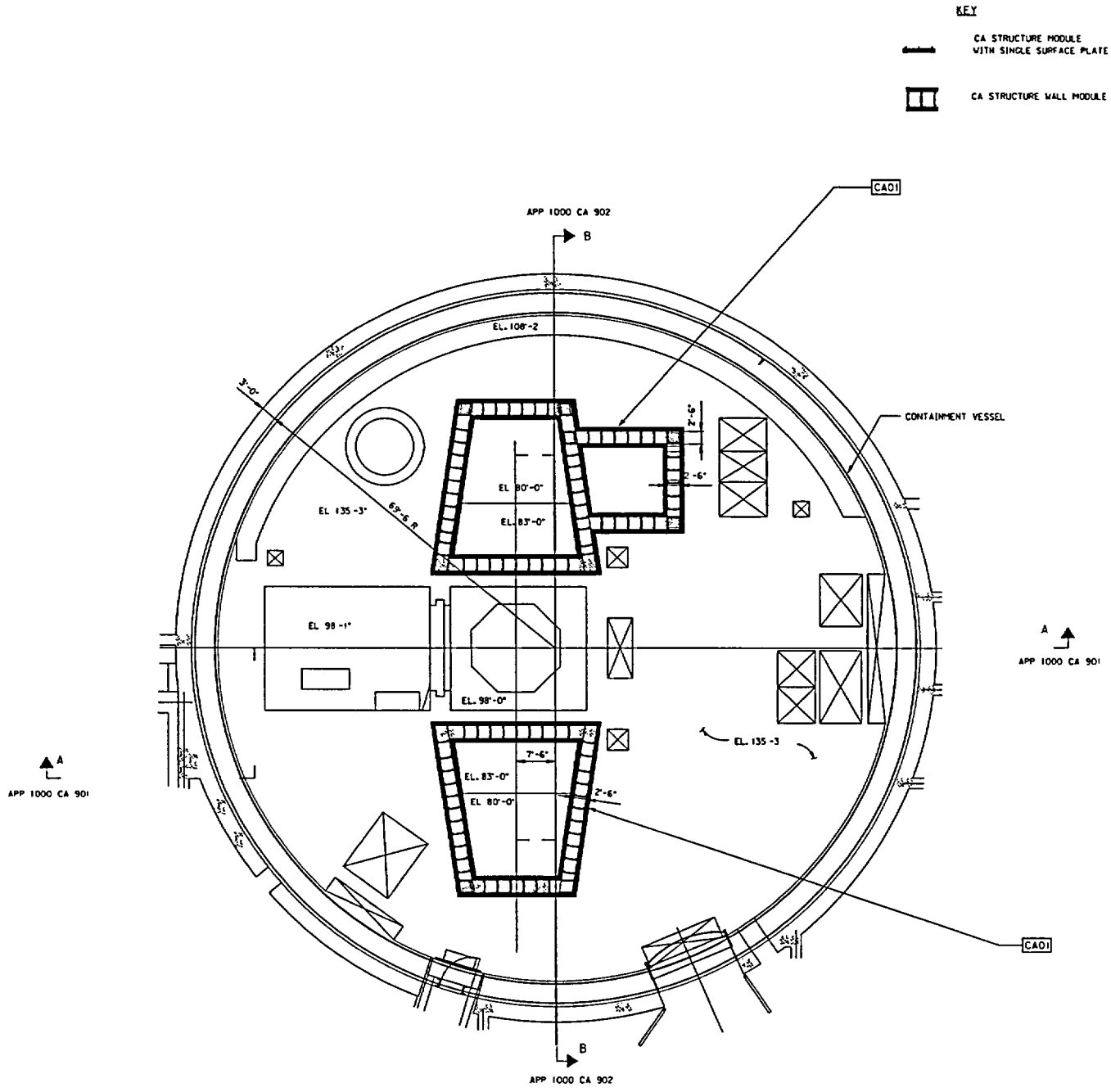

Figure 3.8.3-1 (Sheet 5 of 7)

*[Structural Modules in Containment Internal Structures]**

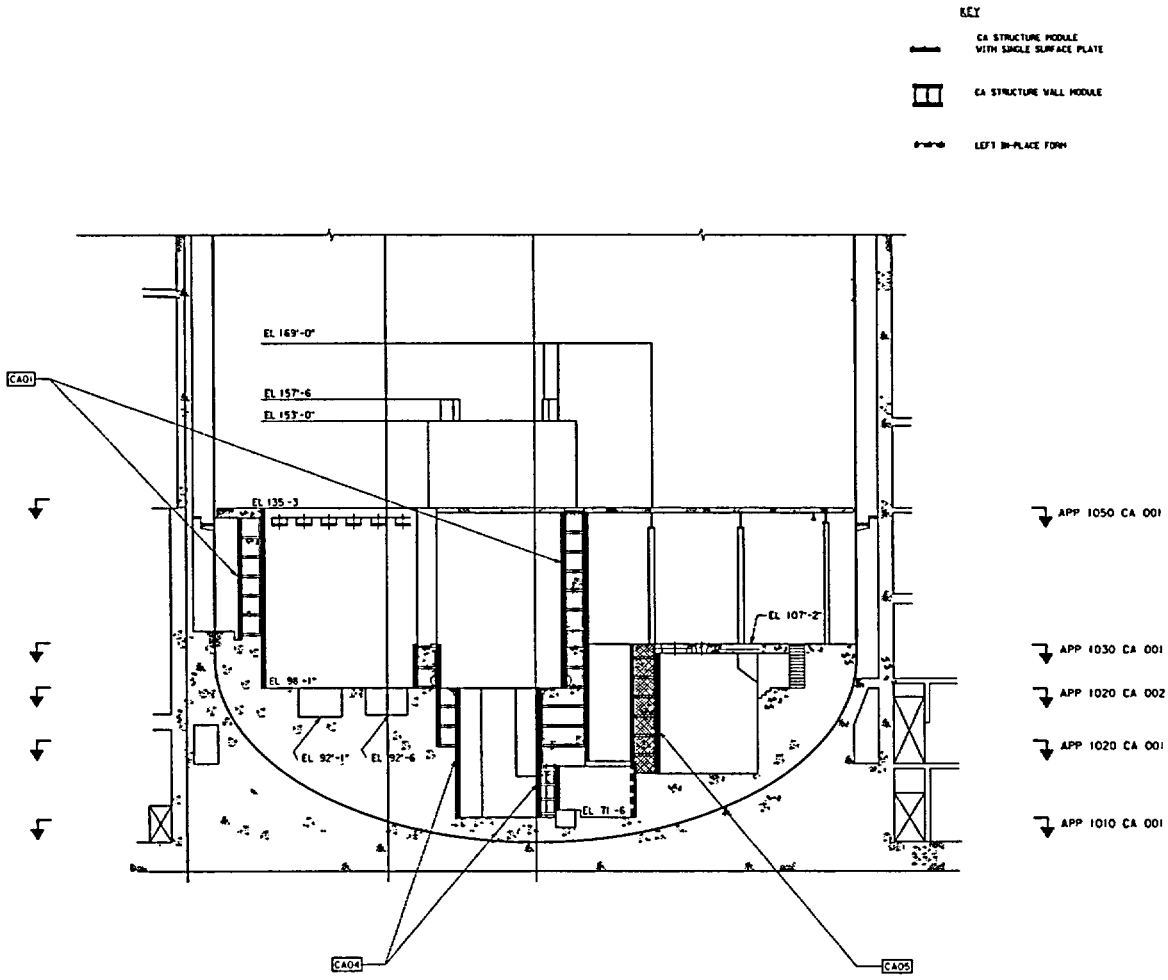

Figure 3.8.3-1 (Sheet 6 of 7)

*[Structural Modules in Containment Internal Structures]**

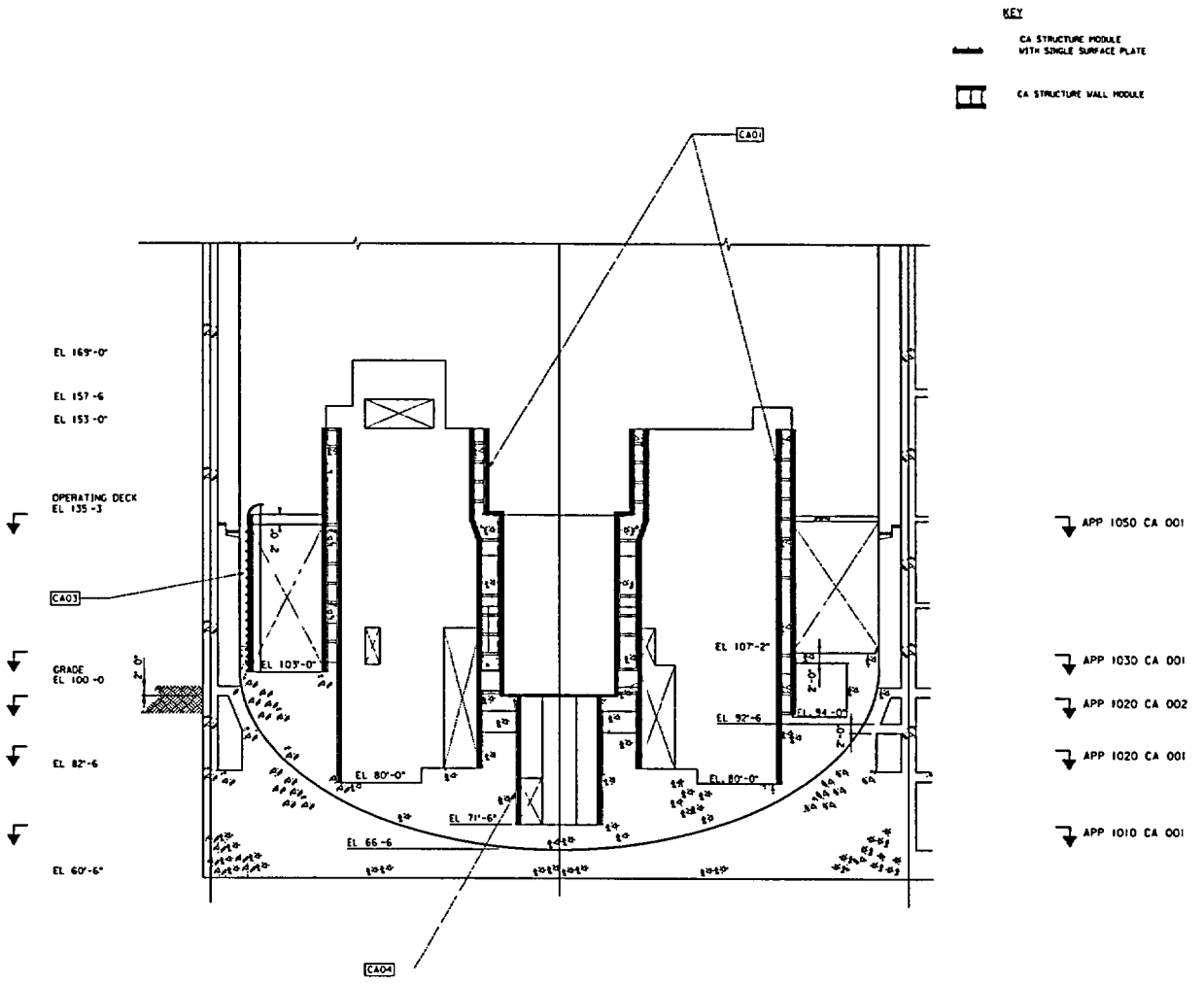

Figure 3.8.3-1 (Sheet 7 of 7)

*[Structural Modules in Containment Internal Structures]**

AP1000 DESIGN CERTIFICATION REVIEW

Response to Request For Additional Information

RAI Number: 220.013

Question:

AP1000 DCD Subsection 3.8.4.2, "Applicable Codes, Standards and Specifications," references American Concrete Institute (ACI)-349-01, plus supplemental requirements as indicated in Subsection 3.8.4.5. Subsection 3.8.4.5.1 states "Supplement requirements for ACI-349 are given in the position on Regulatory Guide 1.142 [TITLE] in Appendix 1A." The staff notes that this statement and the discussion in Appendix 1A are not designated Tier 2*, although ACI-349-01 itself is designated Tier 2*. Subsection 3.8.4.5.1 also states "[Design of fastening to concrete is in accordance with ACI-349-01, Appendix B.]*"

In Appendix 1A, Westinghouse indicates that the AP1000 position "conforms" to all applicable Regulatory Positions C.1 through C.15 of RG 1.142, Rev. 2, November 2001. A general exception is noted because the RG endorses ACI-349-97, not ACI-349-01. Westinghouse indicates that "The AP1000 uses the latest version of industry standards as of October 2001." In reviewing Appendix 1A, pages 1A-52 and 1A-53, the staff noted two apparent typographical errors. In relation to C.6, it should be "Section 9.2.1" instead of "Section 9.3.1," and in relation to C.15, it should be "Section 11.6" instead of "Section 1.6."

Since the staff has not formally reviewed and endorsed ACI-349-01 at this time, Westinghouse is requested to specifically identify all deviations between ACI-349-97/RG 1.142 and ACI-349-01/Westinghouse Position that affect the AP1000 design, and to provide the technical basis for ensuring that a comparable level of safety is achieved for each such deviation. In addition, Westinghouse is requested to (1) clarify and correct the inconsistency in designation of Tier 2* material noted above, and (2) verify and correct the typographical errors noted above.

Westinghouse Response:

ACI 349 is substantially based on ACI 318 "Building Code Requirements for Reinforced Concrete". ACI 318 is revised on a three or four year cycle with revised codes issued in 1992, 1995, 1999 and 2002. ACI 349-97 was based on the 1992 edition of ACI 318. Revisions were made in ACI 349-01 to make ACI 349 consistent with the 1995 edition of ACI 318. All revisions are marked by a side bar in ACI 349-01. Some of the ACI 318-95 provisions, which have now been included in ACI 349-01, are specifically mentioned in the Regulatory Guide 1.142 endorsing ACI 349-97 and were also specifically considered in the AP600 design. Thus, these changes do not affect the AP1000 design.

ACI 349-01 incorporated substantial changes from ACI 349-97 in Appendix B for anchoring to concrete. This appendix is covered in Draft Regulatory Guide DG-1099.

The changes between ACI-349-97/RG 1.142 and ACI-349-01/Westinghouse Position do not affect the AP1000 design.

Subsection 3.8.4.5.1 is being revised to identify the applicable supplemental requirements for ACI-349 that are given in the position on Regulatory Guide 1.142. These will be designated Tier 2*.

Design Control Document (DCD) Revision:

Correct typographical errors In Appendix 1A, pages 1A-52 and 1A-53, in relation to C.6 and C.15.

C.6	ACI 349-97, Section 9.32.1	Conforms	
C. 15		Conforms	The provisions in Section 11.6 of ACI 349-01 are the same as those in ACI 318-99 (Reference 46).

Revise subsection 3.8.4.5.1 Supplemental Requirements for Concrete Structures

[*Supplemental requirements for ACI-349-01 are given in the position on Regulatory Guide 1.142 in Appendix 1A.* ***The structural design meets the supplemental requirements identified in Regulatory Positions 2 through 8, 10 through 13, and 15.***]*

[*Design of fastening to concrete is in accordance with ACI 349-01, Appendix B.*]*

PRA Revision:

None

AP1000 DESIGN CERTIFICATION REVIEW

Response to Request For Additional Information

RAI Number: 220.014

Question:

AP1000 DCD Subsection 3.8.4.2, "Applicable Codes, Standards and Specifications," references American Institute of Steel Construction (AISC) N690-94, plus supplemental requirements as indicated in Subsection 3.8.4.5. Subsection 3.8.4.5.2 identifies the same supplemental requirements previously accepted by the staff for AISC N690-84. However, AISC N690-94 has not been formally reviewed and accepted by the staff at this time. Therefore, Westinghouse is requested to identify all deviations between AISC N690-84 (with NRC-accepted supplemental requirements) and AISC N690-94 (with identical supplemental requirements) that affect the AP1000 design, and to provide the technical basis for ensuring that a comparable level of safety is achieved for each such deviation.

Westinghouse Response:

ANSI/AISC Standard N690 " Specification for the Design, Fabrication, and Erection of Steel Safety-Related Structures for Nuclear Facilities" is substantially based on AISC "Specification for Structural Steel Buildings, Allowable Stress Design and Plastic Design, Manual of Steel Construction".

As stated in the RAI, ANSI/AISC N690-84 has been previously accepted by the NRC staff, with supplemental requirements added by the staff. It was used for the design of AP600 structures taking into consideration the NRC supplemental requirements. ANSI/AISC N690-84 was based on AISC "Specification for Structural Steel Buildings, Allowable Stress Design and Plastic Design, Manual of Steel Construction", 1978 (8^{th} Edition).

ANSI/AISC N690-94 is based on the 9^{th} Edition of AISC "Specification for Structural Steel Buildings, Allowable Stress Design and Plastic Design, Manual of Steel Construction". ANSI/AISC N690-94 was updated from ANSI/AISC N690-84 and incorporates additional requirements from the 9^{th} Edition of AISC Manual of Steel Construction. This edition of the AISC Manual has been endorsed in Regulatory Guide 1.143 (Revision 2, November 2001) for the design of radwaste facilities.

Westinghouse has reviewed the changes between AISC N690-84 (with NRC-accepted supplemental requirements) and AISC N690-94 (with identical supplemental requirements) and has concluded that these changes do not affect the AP1000 design.

Design Control Document (DCD) Revision:

None

AP1000 DESIGN CERTIFICATION REVIEW

Response to Request For Additional Information

PRA Revision:

None

AP1000 DESIGN CERTIFICATION REVIEW

Response to Request For Additional Information

RAI Number: 220.019

Question:

Subsection 3.8.5.5, "Structural Criteria," provides Tier 2* information applicable to the design of shear reinforcement for the basemat below the auxiliary building. The criteria for AP1000 appear to be a significant departure from the comparable Tier 2* criteria presented in the AP600 DCD and previously accepted by the staff. Therefore, Westinghouse is requested to provide (1) a detailed explanation of the differences between the new AP1000 criteria and the accepted AP600 criteria; and (2) the technical justification that a comparable level of safety will be achieved.

Westinghouse Response:

The criteria for the design of shear reinforcement for the basemat below the auxiliary building of the AP600 required minimum shear reinforcement even if the factored shear forces were very small. For the AP600 on a wide range of soil and rock sites, the design shear forces were of such magnitude that shear reinforcement was appropriate in all locations. For the AP1000 design for a hard rock site, bearing reactions are transmitted primarily below the walls of the auxiliary building and design shear forces in the 6 foot thick basemat are much lower. For such cases Westinghouse proposes to apply paragraph 11.5.5.1 of ACI 349 which does not require minimum shear reinforcement when the factored shear force is less than one half the shear strength provided by concrete, φV_c.

Design Control Document (DCD) Revision:

None

PRA Revision:

None